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# Socio-economic Assessments of Technologies for Adaptation

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# Technology Needs Assessments

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# Socio-economic Assessments of Technologies for Adaptation

Follow-up to the First regional capacity building workshop
(Second round countries)
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# 1. Introductory remarks

- **Technologies for Adaptation** are defined as "All Technologies that can be applied in the process of adapting to climatic variability and climate change." (UNDP Handbook)

- A typology of adaptation technologies:
  - Hard technologies / hardware: tools, equipment, physical facilities etc.
  - Soft technologies / software: knowledge to use the tools and machinery.
  - Orgware: institutional framework or organisation required to implement the technology.

- Sectors commonly used: freshwater resources, forests and ecosystems, agriculture, coastal systems, industry, and health (IPCC AR4).

## 1. Introductory remarks
## Differences between Adaptation and Mitigation Technologies

- Climate adaptation is often the continuation of an ongoing process where the same techniques have been used for generations (e.g. houses on stilts);

- Few technologies are specifically designed for adaptation, rather they respond to broader sustainable development needs (e.g. improved water quality) ;

- Adaptation technologies are generally less capital intensive, suitable to small-scale interventions and local variations and context;

- The effects/outcomes of adaptation cannot be measured by a single indicator (such as $CO_2$e emissions), are dependent on future projections;

- Transfers of adaptation technologies does not necessarily follow a north-south approach of equipment and practises. Technologies may already be in place but face barriers to implementation and use.

# 1. Introductory remarks
## **Starting Point**

National Communications under the UNFCCC, Vulnerability and Adaptation Assessments (V&A)

- Address baseline socio-economic scenarios, climate change scenarios, coastal resources, water resources, agriculture, human health etc.
- Provide essential information on their vulnerability to adverse effects of climate change, and on adaptation measures arising from these effects.

National Adaptation Programmes of Action (NAPAs) enable Least Developed Countries (LDCs) to identify priority adaptation activities.

- The NAPAs focus on urgent and immediate needs, are action-oriented, country-driven and based on national circumstances.
- Short profiles on priority adaptation activities designed to facilitate the development of proposals for implementation.

1. Introductory remarks

# The Development – Adaptation Continuum

Two main categories of adaptation impacts

1. direct climate change risk impacts + indirect development benefits
2. direct impacts on climate risks

**Vulnerability** → **Response to impacts**

**General development issues**

Education, economic dev., health policies, livelihood diversification, gender initiatives

**Laying the foundation for more targeted actions**

Awareness raising at various levels

**Climate risk management**

Mainstreaming in planning processes and policies, climate proofing, technological approaches

**Addressing cc impacts**

Radical or/and costly policies and technological approaches incl. relocation of communities, infrastructure projects e.g. dikes, harnessing harbors

**100** — **Benefits in the absence of climate change** — **0**

# TNA Prioritisation Process and Criteria for selection of adaptation technologies: the case of Cambodia

Prioritization criteria based on the Royal Government of Cambodia's development priorities.

Cambodia has made a clear choice of selecting "no regrets" options.

The technologies are already justified by current climate conditions and would provide real and tangible social and economic benefits for local communities if implemented.

| TNA Criteria |
|---|
| **Reduction of Vulnerability to Climate Change** |
| § Reduction in human casualties<br>§ Reduction in physical damage to property, infrastructure and economic output |
| **Economic Benefits** |
| § Support for sustainable development<br>§ Provision and maintenance of infrastructure<br>§ Increase in productivity |
| **Social Benefits** |
| § Creation of employment and income generation opportunities<br>§ Improvement of public health<br>§ Improvement of education and public awareness<br>§ Improvement of local living conditions |
| **Environmental Benefits** |
| § Improvement of air and water quality<br>§ Avoidance of soil pollution<br>§ Conservation and sustainable use of resources<br>§ Use of appropriate and environmentally friendly technologies |

# TNA Prioritisation Process and Criteria for selection of adaptation technologies: the case of Cambodia

| Sector | No. | Technologies |
|---|---|---|
| **Coastal Zone** | 1 | Mangrove Management (Conservation, Restoration, Sustainable Use) |
| | 2 | Seawalls, Dikes, Barriers |
| | 3 | Storm and Flood Early Warning |
| | 4 | Flood Proofing |
| | 5 | Community Flood Preparedness |
| | 6 | Vegetation Buffer |
| | 7 | Flood Drainage |
| | 8 | Flood Hazard Mapping |
| | 9 | Emergency planning |
| | 10 | Beach Nourishment |
| | 11 | Desalination |
| | 12 | Coastal Setbacks |
| | 13 | Managed Realignment |
| | 14 | Saltwater intrusion barriers |
| | 15 | Awareness Raising and Education on Climate Change Issues |

| Sector | No. | Technologies |
|---|---|---|
| **Water** | 1 | Rainwater Harvesting from Rooftops |
| | 2 | Small Reservoirs, Small Dams and Micro-Catchments |
| | 3 | Wells for Domestic Water Supply |
| | 4 | Community Irrigation Systems |
| | 5 | Household Water Treatment and Safe Storage |
| | 6 | Water Use Efficiency |
| | 7 | Leakage Management |
| | 8 | Water Gates and Water Culverts |
| | 9 | Upper Mekong and Provincial Waterways |
| | 10 | Water Reclamation and Reuse |
| | 11 | Community Flood Preparedness |
| | 12 | Water User Communities |
| | 13 | Community and Household Flood Safe Areas |
| | 14 | Drainage for Roads |
| | 15 | Awareness Raising and Education on Climate Change Issues |

# TNA Approach


*Stage 4*

Step 1: Identify technologies

which can be used to make current and future development states better adapted to climate change, in order to measure the costs and development impacts of implementing these options

**Step 2: Prioritize and assess technologies with Multi Criteria Analysis (MCA): contribution to development goals, socio-economic aspects, and reduction in vulnerability**

Step 3: Prepare Technology Needs Assessment

# 1. Introductory remarks
## **TNA Approach**

- **MCA**: Decision criteria to maximise the project score on indicators with equal or different weights to all impacts.

Criteria for prioritization of adaptation measures

General

- contribution to countries development priorities
- reduction of vulnerability to climate change
- performance of the technology (costs, maintenance, etc)

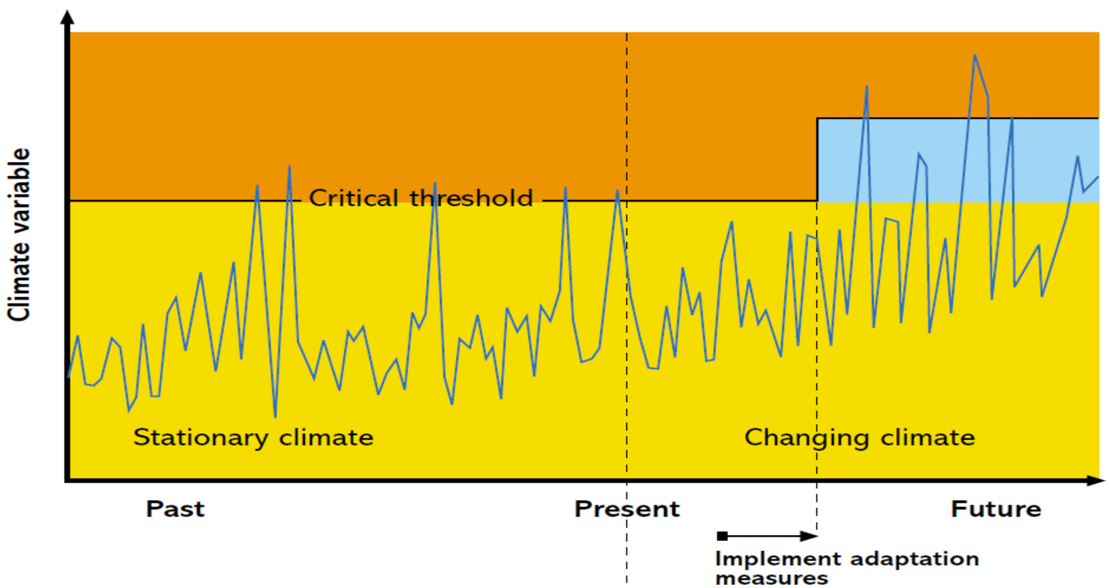
specific

- loss of live and livelihood
- human health
- essential infrastructure
- food security and agriculture
- etc

- Not all CC impacts can be represented by monetary values
  - but socio-economic analyses provide information which can be included in the the MCA

## 2. Socio-economic Assessment of Technologies for Adaptation

- Costs and benefits of adaptation
  - Benefits
    - Avoided damages/welfare loss by reduced CC impacts
  - Costs
    - Cost of planning, preparing for, facilitating and implementing adaptation measures
- Cost assumptions, indirect impacts, and valuation issues
- Uncertainty
  - projections of climate change
  - path of economic growth and technological change
  - behavior



# 2. Socio-economic Assessment of Technologies for Adaptation
## **Key Dimensions, Sustainable Development Contribution and Indirect Benefits**

- **Economic**
  - GDP growth
  - Sectoral development
  - Employment
  - Foreign exchange
  - Investments
  - Regional structure

- **Environmental**
  - Air pollution
  - Water pollution
  - Waste discharge
  - Exhaustible resources
  - Biodiversity

- **Social**
  - Education
  - Health
  - Local participation and sharing of benefits
  - Income distribution
  - Information sharing systems
  - Institutional capacity building

# 2. Socio-economic Assessment of Technologies for Adaptation
## Selection of indicators

| | SD Theme | Indicator | Measurement standard |
|---|---|---|---|
| Economic dimension | - Investment and Costs<br>- Employment<br>- Energy<br>- Water<br>- Food | -Total capital cost<br>-Labour employed<br>-Access and affordability | -Financial cost<br>- No of man hours skilled and unskilled<br>- Energy supply to households and industry (quantity and share) and energy costs relative to income |
| Social dimension | - Poverty alleviation<br>- Health improvements<br>- Education | -Income generation<br>-Health services<br>-Primary and secondary school attendances | -Income to poor households<br>- No. of people with access to health clinic<br>- No of children, time spend on homework |
| Environmental dimension | -Air and water quality<br>- Climate change | - Air pollution<br>- GHG emissions | -Emissions of $SO_2$, $NO_x$ and particulates.<br>-Water pollution.<br>- Climate Change impacts: crops, land etc.<br>-GHG emissions |

3. Examples

# Example 1: Infrastructure planning in Mozambique

**Climate change impacts:**

Significant changes in magnitude and timing of water run-off → increase frequency and scale of flooding

**Vulnerability**

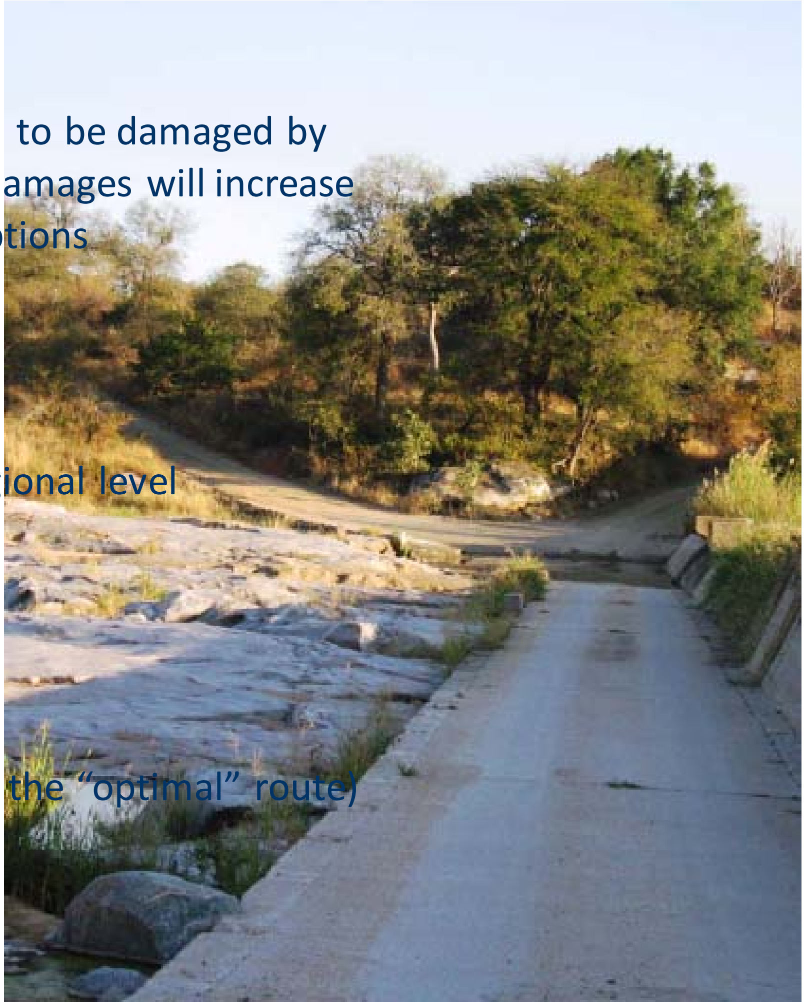
Highways and bridges in Mozambique are expected to be damaged by increasing magnitude and intensity of floods. The damages will increase maintenance costs and can cause temporary disruptions

**Development impacts considered**

- Maintenance and reconstruction costs
- Impacts of disrupted market access at local and regional level

**Adaptation technology options**

- Road drainage systems
- Stronger foundation and bridges
- Alternative routes (use of technology to determine the "optimal" route)



# Example 1: Infrastructure planning in Mozambique, socio-economic impacts

| Indicator | Unit | Total cost of damage per unit, USD | Total cost of damage, mill USD | Cost of re-construction per unit, USD | Total cost of recon-struction |
|---|---|---|---|---|---|
| Number of people displaced | 295,500 | | | | |
| Number of villages displaced | 78 | | | | |
| Number of houses damaged | 47,000 | 580 | 27.0 | 872 | 41 |
| Number of schools damaged | 60 | 37,400 | 2.2 | 37,400 | 4 |

Indirect impacts

- Food price increases of 70 % for three months
- Average normal monthly consumption per person USD 229 per months → USD 390
- Impact on household consumption expenditures and level of food intake, if households adjust to lower consumption levels
- High numbers of morbidity and mortality

# 3. Examples

## Example 1: Infrastructure planning in Mozambique, improved road construction

| | Costs per km (USD) | |
|---|---|---|
| | Without adaptation / Baseline | With adaptation |
| Cost of construction | | |
| Road surface | 190,000 | 190,000 |
| Drainage work | 96,970 | 174,393 |
| **Total cost of construction** | **287,121** | **364,545** |
| Incremental/additional cost | | 77,424 |
| **Total cost of construction, maintenance, and repair** | **1,182,273** | **755,455** |
| Net benefit of mainstreaming the adaptation technology option | | 426,819 |

*NPV over 50 years with a 3 percent discount rate

- upfront costs increase but will be offset by lower maintenance costs over a period of 50 years
- Avoided impacts are considerable and additional to the net benefits in the table

# 3. Examples

## Example 1: Infrastructure planning in Mozambique, Technology Fact Sheet

| Capital costs | |
|---|---|
| Cost to implement adaptation technology | USD 364,545 per km |
| Additional cost to implement adaptation technology, compared to "business as usual" | USD 77,424 per km |
| Total cost, 50 years, NPV, without adaptation | **USD 1,182,273 per km** |
| Total cost, 50 years, NPV, with adaptation | **USD 755,455 per km** |
| **Development impacts, direct and indirect benefits** | |
| Direct benefits | USD 426,819 per km |
| Reduction of vulnerability to climate change | Roads more resilient to flooding<br>Areas with maintained road access stabilize and return to normal conditions faster than in cut-off areas. |
| Economic benefits, indirect | jobs for construction, reliable market access and investments in the road construction industry |
| Social benefits, indirect | Income, training of new employees, reduction in morbidity and mortality since road access will facilitate easier access for emergency and relief |
| Environmental benefits, indirect | Using alternative routes may impact less on ecosystems. Reduction in GHG emissions if using asphalt that gives less resistance to vehicles |

# Example 2: Rainwater Harvesting for crop irrigation in Tanzania

**Climate change impacts:**

Climate change is expected to influence the magnitude and time distribution of precipitation in Tanzania

**Vulnerability**

Water shortage limits the quantity and variety of crops and also has a negative influence on the possibilities for enhanced crop or livestock production in relation to emerging markets. Demand for water storage is extended compared to a situation without climate change. Agriculture can be increasingly dependent on irrigation.

**Development impacts considered**

- Crop yields
- Employment
- Income

**Adaptation technology options**

- Increased water storage capacity for irrigation purposes
- Improved water management
- Adjustment of planting dates

3. Examples

## Example 2: Rainwater Harvesting for crop irrigation in Tanzania socio-economic impacts

Indirect impacts

- Food price increases
- Food availability decrease
- Impact on household consumption expenditures and level of food intake, if households adjust to lower consumption levels
- Increased morbidity

Adaptation technology: Improved and extended water storage capacity utilizing water run-off for paddy rice production

# Example 2: Rainwater Harvesting for crop irrigation in Tanzania, Scenario

| Baseline | Units, Yield (kg/ha) | Price/ Unit | Total value per year, USD | | | | |
|---|---|---|---|---|---|---|---|
| | | | Year 1 | Year 2 | Year 3 | … | Year 10 |
| Revenue | 1,800 | 0.20 | 351.6 | 351.6 | 351.6 | … | 351.6 |
| Total costs | | | 257.8 | 257.8 | 257.8 | … | 257.8 |
| Gross return to average plot | | | 66 | 66 | 66 | … | 66 |

| With adaptation technology | Units | Price/ Unit | Total value per year, USD | | | | |
|---|---|---|---|---|---|---|---|
| | | | Year 1 | Year 2 | Year 3 | … | Year 10 |
| Revenue, Yield (kg/ha) | 3,000 | 0.20 | 585.9 | 585.9 | 585.9 | … | 585.9 |
| Total costs | | | 364.5 | 257.8 | 257.8 | … | 257.8 |
| Gross return to average plot | | | 154.97 | 229.7 | 229.7 | … | 229.7 |

# Example 2: Rainwater Harvesting for crop irrigation in Tanzania Technology Fact Sheet

| Capital costs | |
|---|---|
| Cost to implement adaptation technology | USD 365 per rainwater harvesting technology |
| Additional cost to implement adaptation technology, compared to “business as usual” | USD 106 |
| Annual cost, without adaptation 10 years | USD 330 |
| Annual cost, with adaptation 10 years | USD 365 |
| **Development impacts, direct and indirect benefits** | |
| Direct benefits, without adaptation per year | USD 66 |
| Direct benefits, with adaptation | USD 230 |
| Net benefits, average plot per year | USD 164 |
| Net Present Value of total investment | USD 1555 |
| Reduction of vulnerability to climate change | Improved water management can alleviate the effect from decreased rainfall during crop growing season |
| Economic benefits, indirect | Increased income |
| Social benefits, indirect | Improved health conditions from decreased malnutrition (which is also a key vulnerability factor in relation to malaria). Improved food security. |
| Environmental benefits, indirect | Less depletion of soil |

## Concluding remarks

- Important to illustrate the benefits, direct and indirect of adaptation technologies

- There is a large potential for integrating climate change adaptation technologies into already existing and on-going development programmes, projects and planning efforts
  - this can be done for relatively low costs
  - but needs to consider context specific conditions

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# Thank you !

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